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The Warp Sizing Research

A New Director and a New Program

THE initial program of the warp sizing research, that has been in progress under the auspices of U. S. Institute for Textile Research, Inc., at Massachusetts Institute of Technology since last Summer, and that has involved a basic study of the properties of starches as sizing materials, is approaching completion, and the Administration Committee is now engaged in developing a program covering gelatines and glues for the sizing of synthetic warps. In the planning of the latter they have the co-operation of some of the leading authorities on these materials and on the processing of yarns and fabrics on which they are used for sizing.

Unlike the study of starches, which has been rather closely confined thus far to basic laboratory work, the research on gelatine sizing will start with experimental work under mill conditions after a preliminary study of the literature of these materials. The data thus obtained under controlled conditions will be scientifically tested in the laboratory, and is expected to provide the basis for fundamental study of the materials, the machines employed, and the sized, desized and finished products.

Dr. J. R. Katz, who has been the director of the study on starches, is completing the reports on this phase of the research, and will thereafter be engaged with future work only on a consulting or advisory basis. He is succeeded as director by Mr. W. E. Yelland, who has been his assistant thus far, and the latter will have the services of several laboratory specialists. Dr. M. C. Desai, who has been working in the laboratory under Dr. Katz, and who has donated to U. S. Institute the results of his valuable work on starches, is planning to return to India in the near future. In addition to his future advisory services for the warp sizing study, and to his lecture engagements, Dr. Katz has under consideration acceptance of consulting work involving X-ray and other colloidal work on substances of high molecular weight, such as starches, cellulose, proteins, polymerizates, etc., on which he has specialized.

(*Continued on Page 222*)

Creep in Cellulose Acetate Filaments

By R. L. STEINBERGER *

Fellow of the Textile Foundation

Abstract

The elongation of a series of single cellulose acetate filaments stressed for a period of 29 days with a constant load has been measured at relative humidity values ranging from 0 to 100% in nominal steps of 10%. The creep (elongation under constant stress) continues indefinitely but at a rapidly decreasing rate in all the fibres. The rate of creep is found to decrease with the total time of stressing with certain superimposed discontinuities which seem to indicate transitions from one manner of shear slip to another. The amount of creep at the end of any arbitrarily fixed time increases slowly between 0 and about 60% relative humidity, but above 60% the increase is very rapid. Rupture seems to be governed by a limiting elongation (maximum strain).

Introduction

THE present study is an extension of the previous work as published in *Textile Research*.[1, 2, 3, 4] Quoting from the last cited article we find in the conclusions, page 553, "the complete stress-strain relation is an exceedingly complicated function, a direct attack on which cannot be very fruitful as far as yielding generally applicable constants or laws is concerned until the various phenomena involved are defined, separated and quantitatively measured in specially designed simple experiments."

The first elementary experiment which suggests itself is the measurement of the extension, or "creep," to borrow a term from the metallurgists, of a fibre under constant tensile load. A report on a number of such experiments is the content of this paper.

Specifically, then, the object of the present experiments is to determine the creep of single fibres of cellulose acetate at room temperature when stressed with a constant load of 2 grams; creep determinations to be made at eleven relative humidity (R.H.) values ranging from 0 to 100% in nominal steps of 10%.

Preparation and Mounting of Specimens

Since the plan of this study involves measurements on many fibres, the more exact technique previously used and described in references [1, 2, 3, 4] is out of the question. The fibres were held by shellac rather than by the

* Dr. Steinberger is working under the direction of Prof. P. W. Bridgman, Harvard University, Cambridge, Mass.

special clamps. Also cross-section determinations on each stressed fibre, which is a time-consuming and risky operation from point of view of failures, was not attempted. Since the present results are not intended to be extremely precise in an absolute sense, the section variation from fibre to fibre in the yarn was not sufficient to cause large error. Another departure from previous technique, in the interest of economy of apparatus and time, was the static exposure of the fibre to the humidified air rather than the use of a constant air flow. The flow method is more useful in treating masses of fibres into which diffusion would be too slow.

The writer expects to continue the present type of measurements on the other kinds of rayons. The selection of the acetate type for the first measurements was more or less accidental except in that the selection follows naturally from the previous work quoted.[1, 2, 3, 4] The specimens used were from 150 denier (40 filament) yarn.

Each experiment involving one fibre at a definite R.H. was set up as a unit (see Fig. 1). The fibre was enclosed in a large test tube (1″ diameter

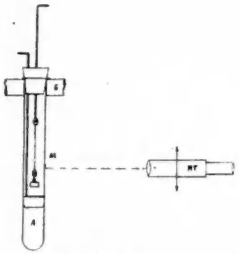

FIG. 1

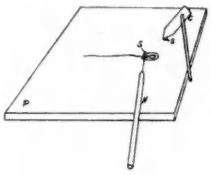

FIG. 2

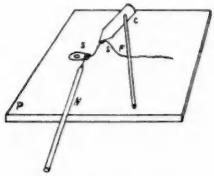

FIG. 3

x 8″ long), closed with a cork stopper. Two holes were pierced through the stopper parallel to the axis—one near the outside and one near the center. Through each hole was thrust a 1/16″ brass wire. The wires slide readily through the holes but with sufficient friction to support about 200 grams without slipping. The wire near the axis of the stopper was provided on the lower end with a small hook to serve as support for the fibre. A disc of copper or brass screen was soldered eccentrically and perpendicularly to the lower end of the other wire. The upper 3/4″ of each wire was bent at right angles to serve as adjusting handle. Ten cc. of acid solution (A, Fig. 1) were carefully placed in the bottom of each tube. It is essential that no acid droplets be left adhering to the sides of the tube. The fibre may swing over in contact with the drops. The acid calibration data are given in Table I.

The operation of the tube and mounting is quite obvious. The screen disc serves as a movable platform which supports the weight until the time for stressing the fibre has arrived. By means of the other wire the fibre may be accurately adjusted with respect to the fiduciary mark (M) on the tube and with the measuring telescope (RT). The loading weights were provided with wire hooks and were adjusted to 2.000 ± .002 grams.

Since the fibre specimens are exceedingly small bodies, a description of their handling technique is necessary. The selected fibre is attached to two

TABLE I

Mounting No.	Calibrated % R.H. at 25° C.	Unit stress kg./mm.²	Initial fibre length in mm.	
			Series 1	Series 2
0	0	6.34	41.7	35.3
1	9.5	6.39	42.9	38.7
2	20.6	6.44	41.5	38.8
3	30.2	6.49	43.0	38.0
4	39.2	6.54	37.8	39.2
5	50.0	6.59	41.7	39.1
6	60.0	6.63	43.0	47.2
7	71.0	6.69	40.5	38.3
8	79.5	6.73	41.5	37.4
9	90.0	6.78	26.1	37.1
10	100	6.83	*	*

* No fibre was mounted in the 100% R.H. tube because preliminary tests had shown that rupture was instantaneous with a load of 2 grams.

tabs, each punched with a 3 mm. hole (see Figs. 1, 2, 3). The upper tab, which is hung on the hooked wire in the mounting tube, is made of copper foil. The lower tab is made of black paper. The foil is not as easy to handle as the paper, but is necessary because the paper yields slightly under stress. Yield in the support must be carefully avoided. The fibres were attached to the tabs by melted flake shellac, *not* shellac solution in alcohol. In order that the shellac adhere to the foil, holes should be pricked into it with a needle. The fibres were about 45 mm. long between tabs. Dimensions of the apparatus dictate this length.

In attaching the tabs the selected fibre is placed on a 6″ x 6″ x ¼″ plate of polished black bakelite (P) where it is quite visible when properly illuminated (Fig. 2). The hard smooth surface is necessary. When the fibre and tab are held down by the dissecting needle (N) the hard unyielding base material will prevent the tab from tipping. The shellac flake is melted by a small "soldering copper" of the form shown at (C), (Figs. 2 and 3). The copper has a length of 1¼″ and a diameter of 5/16″. The handle made of iron for low heat conductivity is set into the copper at right angles to its axis. It is very essential that the shellac be applied to the fibre end as shown in Fig. 2. If it is applied incorrectly, as shown in Fig. 3, the fibre (F) will come away from the bakelite by adhesion to the drop of molten shellac (S) on the bottom side of the copper. In applying the shellac to the heated copper the flake should be clamped horizontally. The heated copper is then touched to it with a downward motion. If the operation is done correctly and the copper is just hot enough, a small bite about 1/16″ square will be melted out of the edge of the shellac and will adhere to the underside of the copper point in a small droplet where it can be applied to the fibre and tab most readily. The bakelite board should be large enough (6″ x 6″) for the handle of the dissecting needle (N) to rest on it. The average experimenter is not steady enough to hold the point of the needle on the fibre free-hand.

By means of the two tabs the fibre may be handled conveniently without danger of overstraining. The paper tab with its drop of shellac weighs only about 2 mg., which is insufficient to cause yield of the fibre but is enough to keep it hanging straight and vertically from the wire hook. The tabs have the shape shown in Figs. 1, 2 and 3. The size may be judged by the punched holes which are 3 mm. in diameter. Before mounting in the tube the zero length of each fibre is measured with dividers. The copper tab is then hung on the wire hook; the required weight, 2 grams in this study, is placed in the center of the screen platform. The whole assembly is then placed in the proper tube with acid solution. By tilting the tube and adjusting the weight and fibre the weight hook can be passed through the lower tab hole *without imposing any stress on the fibre.* This is very important. The tube is then set aside in the support rack (S), Fig. 1, for equilibrium to be established between fibre and water vapor over the acid solution. Over night has been set arbitrarily as the conditioning time which seems to be ample. During the conditioning period the fibre hangs freely with only the 2 mg. weight of the paper tab keeping it taut.

On the outside of each tube just above the level of the lower tab a small piece of gummed label (M)) is attached, the edge of which serves as fiduciary mark from which the displacement of the lower tab due to fibre extension is measured. The fiduciary mark is necessary, for one measuring telescope was used for all fibres and hence had to be moved on its support for measurement of each fibre. The tubes were placed in a series of holes in the board (S), Fig. 1, which was screwed permanently in a horizontal position above the laboratory table. The tubes were arranged in arcs of two concentric circles with the reading telescope cross-hairs at the center. It was therefore necessary to focus only twice, once for each circle.

Method of Measurement

In principle the measurements were simple in the extreme. The position of the lower tab was determined as a function of the time of stressing. There are certain details, however, which bear mention. At time zero the weight platform is pushed down so that the weight is applied gently to the lower tab, thus putting the whole 2 g. load onto the fibre. The measuring telescope cross-hairs must be moved rapidly during the first minute to keep up with the movement of the tab, for the initial extension of the fibre is quite rapid especially at high R.H. Readings of the tab position were made at 15-second intervals during the rapid extension period, then less frequently thereafter. During the rapid extension a buzzer and clock were arranged to signal 15-second intervals so that the cross-hairs could be watched constantly.

It would be interesting to get the time vs. extension in the first 15 seconds, but this cannot be done with the present method which requires manual setting of the cross-hair.

Results and Description of Curves

All results are given graphically. Percentage elongation (e) is plotted against time (t) as abscissa in all charts except No. 6, where the value of e at $t = 3$ minutes is plotted against % R.H. In all cases the load was constant at 2 grams. However, the unit stress rises in proportion to e

because of shrinkage of section area. In Table I are given the unit stresses actually existing in the fibre as computed from the average section area.

Two series of fibres of eleven each were tested. In Series 1 the elongation of each fibre was observed from $t = 0$ to $t = 100$ minutes, then the tube was unclamped and set aside to await the next reading. The moving of the tube caused shifting at the supports and thus destroyed the usefulness of the measurements at values of t greater than 100 minutes. The readings below $t = 100$ minutes were acceptable because in this interval the tube was not disturbed. The data will be found plotted for comparison with curves for Series 2. Series 2 was arranged initially and permanently in a rigid board from which the tubes were not removed until after completion of the whole run.

Because of the extreme range of the time coordinate, three scales are used, one extending from $t = 0$ to $t = 10$ minutes; the second from $t = 0$ to $t = 100$ minutes; and the third from $t = 0$ to more than 41,800 minutes, over 29 days.

In Figs. 4 and 5, e vs. t is plotted for the two series of fibres up to $t = 10$ minutes. Note that the e scale in Fig. 4, Series 1, is greater than for Series 2, Fig. 5. Qualitatively the two families are the same. All the curves from 0% R.H. to 60% R.H. are bunched closely together at low values of e. Beyond 60% R.H. the extension is much more rapid. In all curves there is an initial rapid rise. The slope tends toward zero as time goes on. The general form of all the curves suggests a logarithmic formula. In Series 1 the 90% R.H. fibre broke as soon as the weight was hung. In Series 2 the 79.5% R.H. fibre is anomalous in that its extension is less

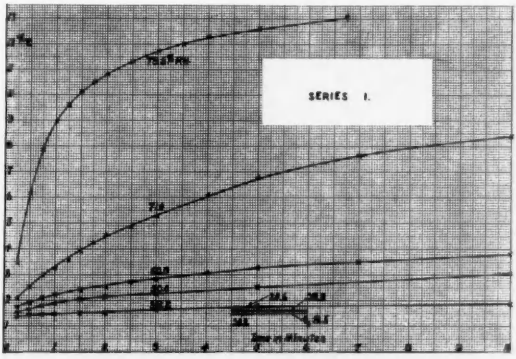

FIG. 4

than for the 71.0% fibre. We may take Fig. 4 as representative of the relative short-time creep (less than 10 minutes) of these cellulose acetate single filaments when loaded at a unit stress between 6.3 and 6.8 kg/mm.²

The strains at $t = 3$ minutes were read from Figs. 4 and 5 and are plotted in Fig. 6 with % R.H. as abscissa. Circles represent fibre Series 1 crosses Series 2. Agreement is good with the exception of the two points at 71.0 and 79.5% R.H. of Series 2. The extension at three

minutes remains practically constant up to 50% R.H. Thereafter a very rapid rise sets in. Breakage is instantaneous at 100% R.H. under a stress of 6.3 kg/mm² (2 grams wt.). It may be that the strain under

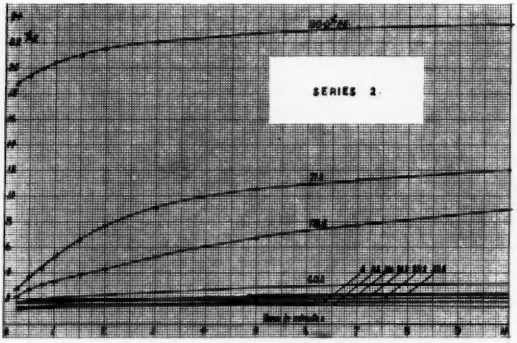

FIG. 5

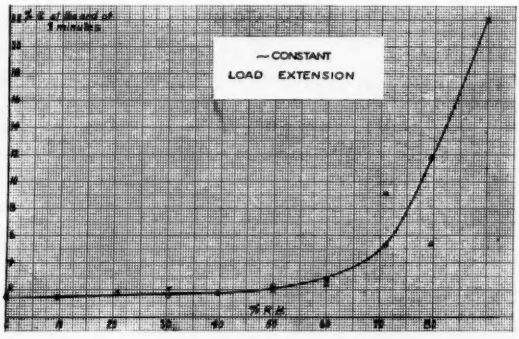

FIG. 6

standard conditions at the end of 3 minutes, or any other arbitrarily set convenient time, would be a good practical index of fibre quality. Before this could be established a search would have to be made to establish a correlation between e at $t = 3$ minutes and practical working qualities of the fibre.

All the remaining curves from Figs. 7 to 21 inclusive are plotted on semi logarithmic paper. The % strain e is plotted linearly against log. t as abscissa. The purpose of the logarithmic plot is two-fold. The time axis is greatly contracted, making possible the plotting of long time runs, and, what is more important, the equation for certain portions of the curves is revealed.

Figs. 7, 8 and 9 give plots for all measurements on fibre Series 1. Figs. 7 and 8 have a larger ordinate scale than Fig. 9, in order to show

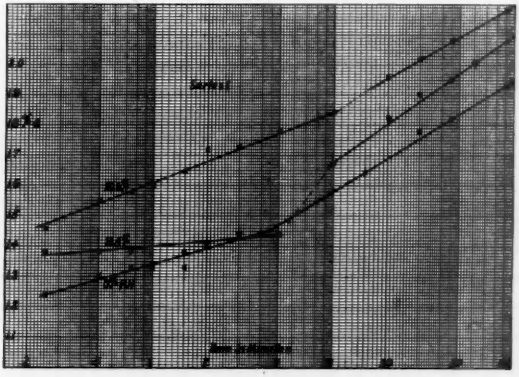

FIG. 7

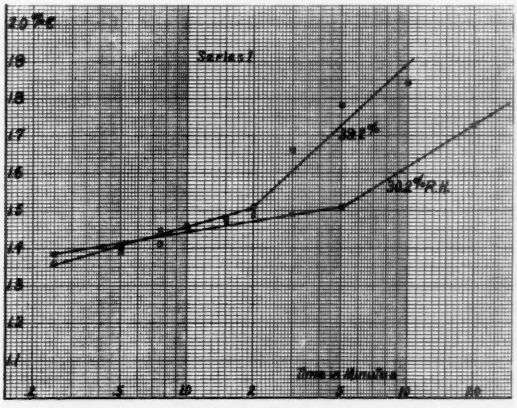

FIG. 8

that the segmented character of the curves is present even at low values of e and R.H. Note that straight lines may be drawn through most of the points with a considerable degree of confidence.

Similar plots are given in Figs. 10 to 13 inclusive for fibre Series 2. But here the time range is much greater over 41,800 minutes, or about 29 days, and the fibres which have not broken are still stretching at a diminishing rate at the time of this writing. The three fibres 71.0, 79.5 and

90.0% R.H. broke respectively at 10,000 minutes (6.95 days), 6,300 minutes (4.38 days), and 2700 minutes (1.88 days). As stated before, the 100% R.H. fibre broke immediately after applying the load. The

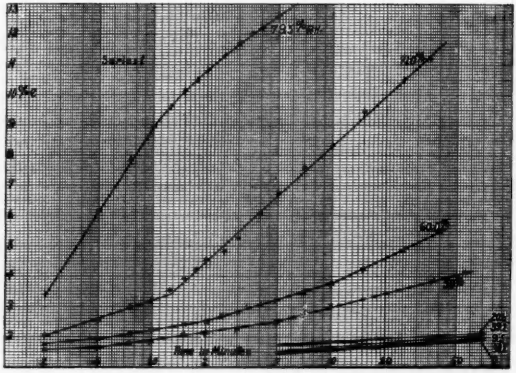

FIG. 9

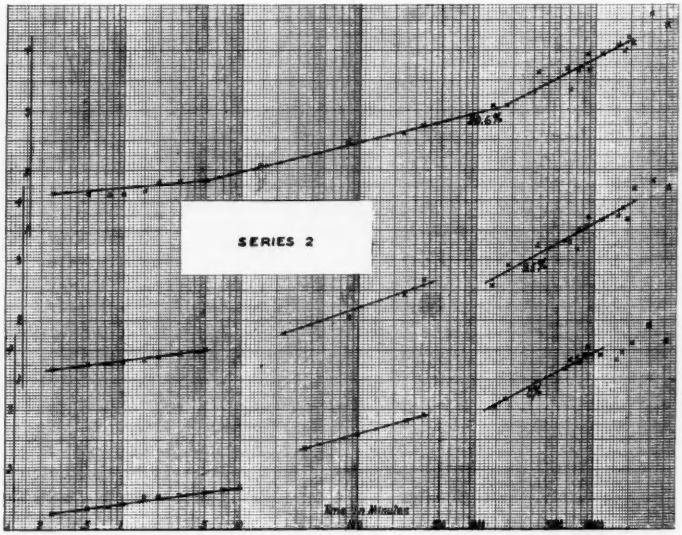

FIG. 10

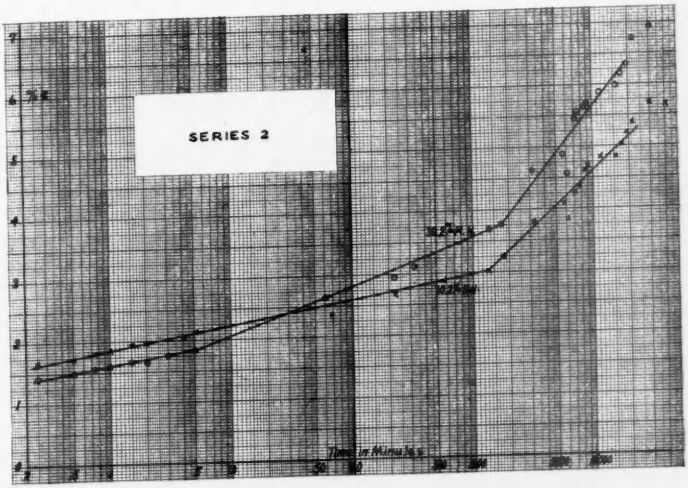

FIG. 11

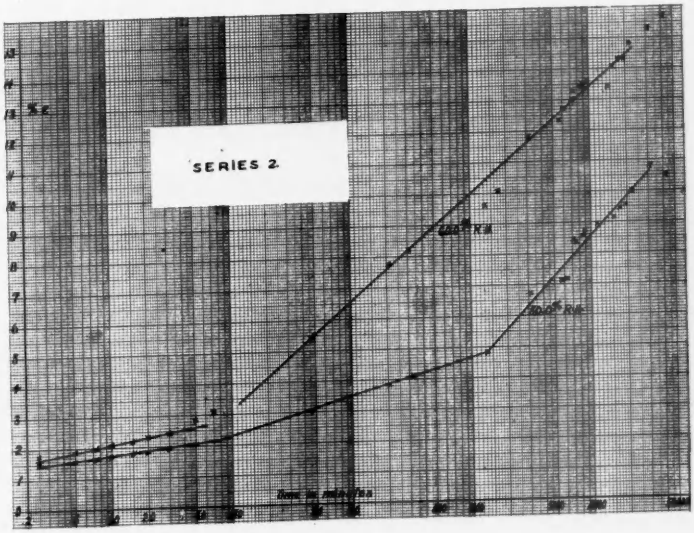

FIG. 12

predominating behavior over the whole long-time interval seems to yield a curve with a maximum of three linear segments of successively increasing slope. However, there are notable exceptions. The following curves have but two segments: 30.2, 60.0 and 90.0% R.H., and the second segment of the 90% curve has a smaller slope than the first. The curves of

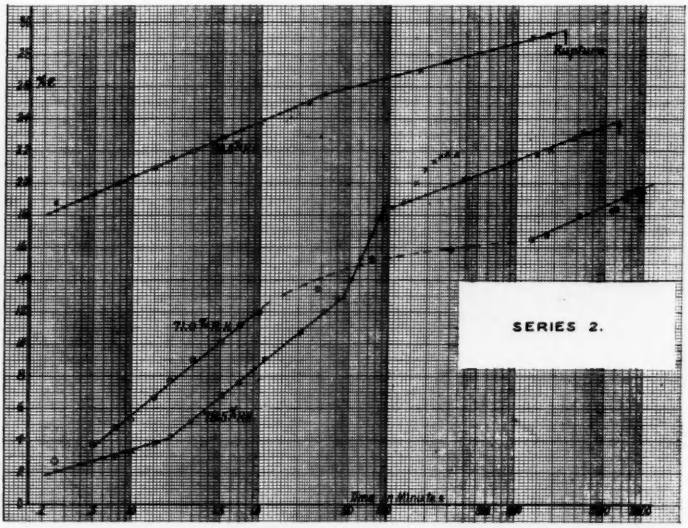

FIG. 13

Fig. 13 for 71.0 and 79.5% assume what we may call their natural order above t = 60 minutes, but below their behavior is irregular. The large hump at t = 300 minutes in the 79.5% curve is due to an extraordinary rise in room temperature during the night. The room in which this work was done is not provided with a temperature regulator. The scattering of the points on all curves above t = 10,000 (7 days) is due to poor thermal regulation which makes itself felt more markedly at large values of t because the interval of time between successive observations toward the high end of the curves becomes greater as time goes on and the effect of temperature on the rate of strain has more time to act. Future measurements will be made under more accurately controlled temperature conditions.

In spite of the obvious irregularities, straight lines are very persistent and apparently indicate something fundamental in the behavior of the fibres.

In the remaining log. plots (Figs. 14 to 21 inclusive) strain is plotted for the first 100 minutes range in time, the purpose being to make a direct comparison between the curves for the two fibre series taking the relative

humidities one at a time. The agreement is fair for all R.H. values, save 71.0 and 79.5%. What differences there are seem to be inherent in the fibre and are not due to experimental error.

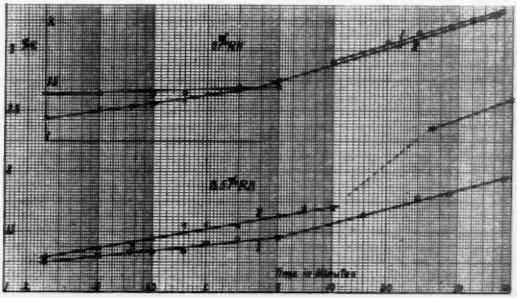

FIG. 14

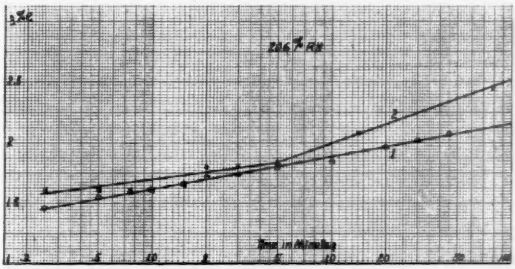

FIG. 15

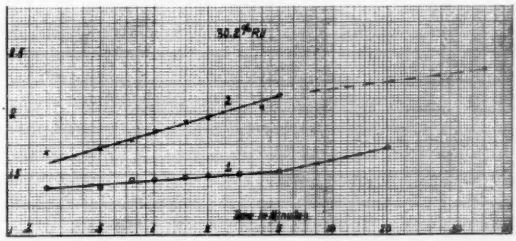

FIG. 16

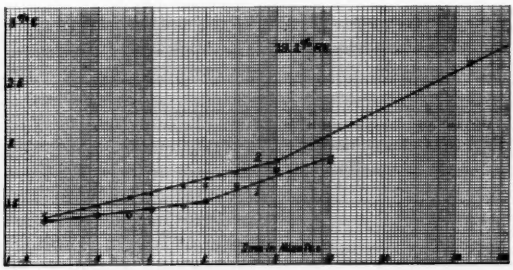

FIG. 17

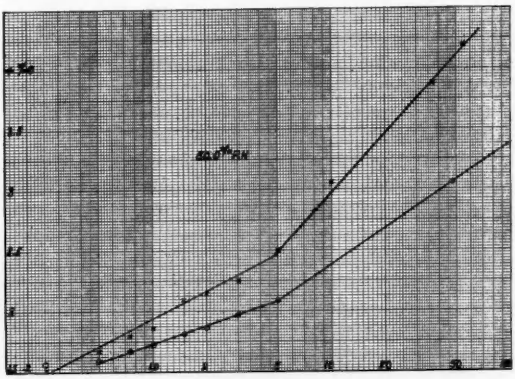

FIG. 18

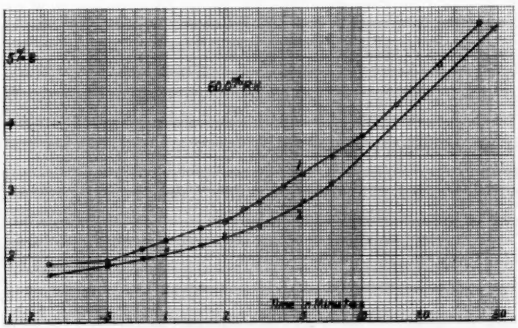

FIG. 19

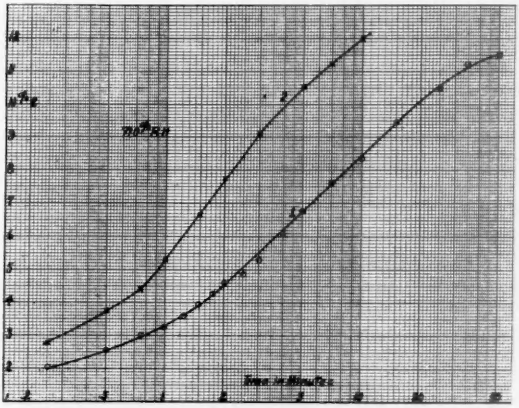

FIG. 20

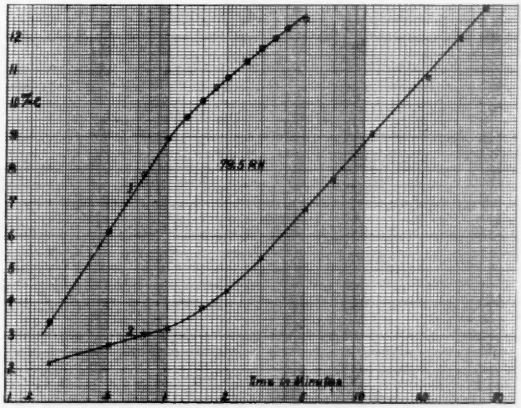

FIG. 21

Discussion of Results

The density of the acid solution in the 71.0, 79.5 and 90.0% tubes was tested after breaking of the fibres and was found to give an R.H. value which agreed with the recorded value to less than 0.5%. It may therefore be safely concluded that the R.H. in the other tubes did not change during the tests by an amount sufficient to cause error in strain measurement. The acid density in the other tubes has not yet been tested

except for the initial calibration, because the writer wishes to continue observation of strain as long as possible. Removal of the stopper is therefore out of the question.

The equation for a given length of straight line on the logarithmic plots is

$$e = k \log t + c \tag{1}$$

where the constants k and c have in general different values for each segment. It then follows that

$$\frac{de}{dt} = \frac{k}{t} \tag{2}$$

for a given segment. At a break in the curve one or both of the parameters, k and c, change suddenly to give a new clearly-defined straight segment, while in the cartesian plotting only a gentle inflection occurs. As an illustration of the greater clarity of the logarithmic plot in revealing the inflection points, compare curve for 79.5% R.H. plotted logarithmically in Fig. 13 and in cartesian co-ordinates (Fig. 22). The log plots

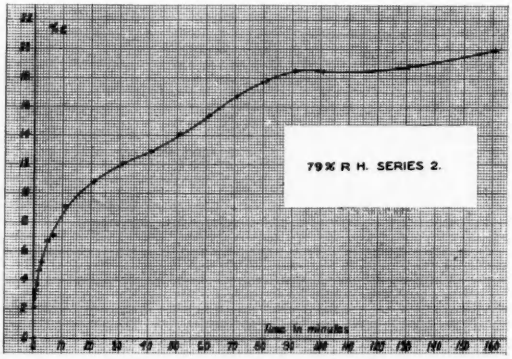

FIG. 22

give the erroneous impression that e increases indefinitely with time, while in reality the rate of change of slope decreases continually no matter what the value of k or c.

For the sake of discussion in Fig. 23a are drawn schematically, but not to scale, two cartesian plots corresponding with the first two segments for a typical run. The same curves are given again schematically in Fig. 23b with log t as abscissa. The normal behavior seems to be that the extension follows No. 1 curve (both Figs. 23a and 23b) to the point of intersection, then jumps to No. 2 curve defining another mode of shear slip. But there are a number of abnormal runs where the straight segments do not join smoothly (see Fig. 7, 9.5%; Fig. 16, 14% and 9.5%). In these cases the jump from one mode of slip to another either (a) lags

or (b) anticipates the intersection. Take the 9.5% curve of Fig. 7 as typical of case (a). The state point travels through the intersection

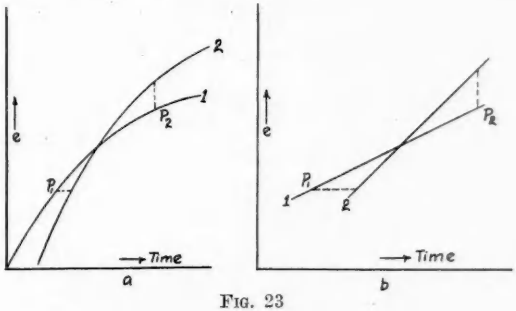

FIG. 23

(Fig. 23 a and b) to point P_2 on curve No. 1 extended; then a sudden jump is made to curve No. 2 with a corresponding increase in e. The same description holds for the jump between 10 and 30 minutes on the 0% curve of Fig. 10 and for the small jump on the 20.6% curve of Fig. 7.

The state point may anticipate the intersection, as indicated by the horizontal line drawn in Fig. 23 a and b from point P_1. The shear may change at the point P_1 from a mode characteristic of curve No. 1 to one characteristic of curve No. 2. Of course at P_1 the jump from curve No. 1 to curve No. 2 cannot be made downward, for this would mean a shrinkage of fibre length. Instead, the state point moves horizontally as the strain remains fixed. Examples of such behavior are shown in Fig. 10 curves 0% and 9.5% between $t = 400$ and $t = 1000$, and in Fig. 13 between $t = 10$ and $t = 1000$ on curve 71.0%.

The normal process seems to be illustrated by a movement of the state point along curve No. 1 (Fig. 23 a and b), then a jump to No. 2, a curve of greater slope. This rule is violated in all three curves of Fig. 13. The first straight segment in both the 71.0% and 90.0% curves has a greater slope than the second; also in the 79.5% curve the third straight segment has a slope greater than that of the fourth.

In simple tension there exists a shearing stress along planes included to the axis of the fibre. The value of the shear stress reaches a maximum of half the tensile stress on planes inclined at 45°, and since the average tensile stress on the fibre is 6.50 kg/mm², the maximum shear stress is 3.25 kg/mm². The segmented character of the curves suggests that all the shear strain does not follow the planes inclined at the same angle to the axis.

Previous work had shown similar discontinuities in the plastic region when strain was plotted against increasing stress,[4] which, taken with the present results, confirm the general conclusion of other observers that the synthetic fibres are not wholly amorphous or vitreous and homogeneous, but possess a certain amount of internal structure.

According to Jeffries,[5] a body possesses strength if the rate of change of shape decreases with time of application of stress. If the stress on a

body is increased to the value (S), below which the rate of change of shape continually falls with time and above which the rate of change of shape remains constant or increases with time, the stress (S) is called the strength of the body. If (S) is zero in Jeffries' terminology the body is devoid of strength. With this understanding of strength, these cellulose acetate fibres possess strength at room temperature and relative humidities up to 90%, and the strength is greater than the stress due to the 2 gram load despite the fact that this load can cause rupture at 71.0, 79.5 and 90.0% R.H. Data above 90% R.H. could not be obtained because of too rapid elongation.

In the three cases (Fig. 13) where rupture was actually observed the break took place without a warning increase in extension rate. It occurred in the uniform straight-line segment of the log. curve. This suggests that there is no appreciable necking down. Microscopic examination of the break confirms this. The break plane, which of course is not smooth in the single fibre observed, cut across the fibre at an angle of about 60° to the axis. Rupture seems to be determined by a shear strain maximum.

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Some Physical Properties of "Casein Rayon"

"THE German State Institute for Applied Botany of Hamburg has," states *Die Chemische Industrie*, "examined samples of the 'synthetic wool' prepared from casein in Italy by A. Ferretti (of *C. T. J.* and *C. E.*, Nov. 15, 1935, P. 409), the report issued by the Institute on the subject being to the following effect: The sample, better described as 'casein rayon,' consisted of pale cream fibres, with an average length of 3 to 5 centimetres and an average thickness of 0.030 to 0.035 millimetres. The surface of the fibres presented a somewhat rough channelled structure, and the gases produced on combustion had a marked alkaline reaction. The fibre showed no appreciable swelling in water, whilst on treatment with iodine it turned yellowish brown. It was resistant to the action of both cold and warm dilute sulphuric acid. Treated with 10% caustic solution the fibres swelled about 30% and became brittle, particularly on warming. The average tensile strength of the individual fibres was found to be 6 grammes, as compared with the 35 grammes for natural wool. The extensibility at break varied between 5 to 75%, against the figure of 62 to 82% obtained with natural wool."—*The Chemical Trade Journal and Chemical Engineer*, London.

Degradation of Weighted Silk Fibroin By Acid and Alkali*

By JEANETTE E. ROSS, RUTH L. JOHNSON and RACHEL EDGAR

The degradation of plain-woven fabrics of iron-weighted, lead-weighted, tin-weighted, tin-lead-weighted, and zinc-weighted silks by hydrochloric acid and sodium hydroxide in 10 hours at 40° C. has been followed by determining the weight, ash, nitrogen, wet warp breaking strength, and elongation at breaking load of the residual fabrics. These data show weighting is not a factor of the acid or alkaline degradation of silk fibroin and quantitatively compare the degradation of the five weighted silks.

Introduction

WEIGHTED silk, in contrast to silk, has been described as of greater covering power, resilience, and density, of greater resistance to dust,[83] fire, microörganisms, and water, of different dyeing properties and fastness,[87] of less elasticity and luster, and as withstanding laundering less well[21] and being, in general, "much more susceptible to deterioration."[38]

Unequal distribution of weighting and excessive weighting[47] have been cited as causing deterioration in silk. It has been stated that heavily weighted silk contains less combined water of hydration than does slightly weighted silk.[76] In 1929 the Silk Association of America, Inc., prescribed that

> "weighting for satins shall not exceed 50%, for crêpe de chine and canton crêpes 45%, for georgette 30%, for chiffon 10%, and for fabrics for printing 30%."[4]

It has been suggested that weighting may be a catalyst for the deterioration of weighted silk which compounds more readily oxidizable than silk fibroin do not retard.[74, 75, 41, 3] Degree of absorption by fibroin, resistance to mechanical failure, mordanting properties, color, possible toxicity, and cost have been factors in the selection of weighting substances. It has been stated that iron salts mordant silk resistant to mechanical failure[80] and faster to light than tin salts do;[6] that tin-lead-weighted silk is more durable than tin-weighted silk;[5] that tin weighting splits the silk fibre longitudinally[43] and acts as a partial resist in dyeing,[64] but causes

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less mechanical failure upon irradiation than lead weighting does,[40, 9] and lowers the elasticity of silk less than zinc weighting does;[66] that zinc-weighted silk is resistant to mechanical failure [44, 80] and fast to light when dyed with basic colors;[35] and that silicates promote even dyeing of weighted silk [10] and improve its stability to light.[72, 81]

A review of the literature has yielded detailed quantitative data of composition and physical properties only in the case of tin-weighted silks, and no comparative data as to how the amount of weighting or the manner of its application affect the deterioration of silk weighted with different salts. The data presented in this paper describe the acid and alkaline degradation of five weighted silk fabrics of typical commercial quality and as similar construction as available. The black iron-weighted and white lead-weighted, tin-weighted, tin-lead-weighted, and zinc-weighted silks, of unknown history beyond purchase from manufacturer, have been defined by analysis. The effect of the different weightings on the acid and alkaline degradation of fibroin has been measured by loss in weight, inorganic content, nitrogen, wet warp breaking strength, and elongation at breaking load.

Some data of the effect of acid and alkali on the total nitrogen of the residual silk have been recorded by Persoz,[57] Moyret,[52] Silbermann,[60] Steiger and Grünberg,[78, 70] Gnehm and Blumer,[32] Sisley,[71] and Gianoli [25, 27] in development of methods for extracting nitrogenous finishing substances from weighted silks. The action of acid and alkali on weighted silks has been somewhat further described by Persoz,[57] Müller,[53, 54] Ris,[59] Zell,[83] Gnehm and his coworkers,[29, 30, 31, 33, 34] Martinon,[58] Gianoli,[24, 26, 28] Ristenpart,[60, 61] Heermann and Frederking,[40, 42] Cook,[11] Weltzien and Fowinkel,[85] Branegan,[8] and Fisher [22] in their methods for indirect estimation of weighting.

Silbermann found silk weighted with stannic chloride extremely sensitive to light before treatment with alkali.[70] Ristenpart [60] and Meister [51] noted little change in the mechanical properties of silk which had been weighted with tin salts and deweighted. Beizenherz, in the extraction of waste silk for the recovery of weighting substances, was unable to remove more than traces of tin by 2% hydrochloric acid at 50° C.[7] Elöd and his coworkers reported that 0.1 *N* hydrochloric acid removed little tin from silk and that the tensile strength of tin-weighted silk decreased with decreasing pH of its aqueous extract.[16, 17]

Ristenpart described alkali as more effective than acid for dissolving tin weighting from silk.[62] Low concentrations of alkali have been used as a preservative finish [13, 14, 19, 20, 46] for weighted silk and in treatment of stored silk [37] or worn silk garments before dyeing. At higher concentrations of alkali, in the application of developed,[45] vat,[12, 48, 82] or sulfur dyes,[63] weighted silks have been reported to lose luster, scroop, and weighting, to fail mechanically, and to become susceptible to tendering by sulfur dioxide.[48]

Experimental Procedure

The fabrics were conditioned at 70° ± 2° F. and 65 ± 2% R. H. before analysis for yarns,[1, 15] thickness,[1] weight,[1] breaking strength, elongation at breaking load,[1, 84] and folding endurance. The values for folding endurance are averages of the double folds required to sever 10 conditioned cm.-wide specimens in an M. I. T. Folding Endurance Tester at a

tension of 1 kg. and a rate of 175 double folds per minute when folded 135° either side of the no-fold position.[75] The flexural properties of the silks were measured with a Flexometer at the textile research laboratory of the Bureau of Standards. Flexural work, recovered work, and flexural hysteresis have been used as measures, respectively, of the stiffness, resilience, and creaseability of the fabrics.[65]

The nitrogen of approximately five grams of weighted silk, dried to constant weight at 105° C., was estimated by a modified Kjeldahl method and corrected for that produced in blank determinations with the reagents.[50] Each value is the average of four determinations.

Each value for water extract and weighting is the average of four determinations made with approximately five-gram samples.[2] Two samples of approximately four grams each of yarn were dried to constant weight at 105° C. and ignited until constant in an electric furnace at a dull red heat; the ash of the iron-weighted silk was treated with nitric acid and again ignited. For each fabric six samples of approximately five grams were similarly analyzed for total ash.

The phosphorus of the ash was determined gravimetrically,[18a] and the silica as the loss in weight upon treatment with hydrofluoric acid.[23] The residues from the hydrofluoric-acid treatment of the ash of the different silks were then further analyzed; that of the iron-weighted silk was fused with potassium pyrosulfate before solution in dilute sulfuric acid for the volumetric determination of iron[68c] and the colorimetric determination of chromium;[68b] the lead of the lead-weighted and tin-lead-weighted silks was weighed as the sulfate,[68d] and the tin of the tin-weighted and tin-lead-weighted silks as stannic oxide;[18b] the aluminum of the zinc-weighted silk was weighed as the oxide[68a] and the zinc was determined volumetrically.[68e] The chromium and iron of the iron-weighted silk, the tin and lead of the tin-lead-weighted silk, and the aluminum and zinc of the zinc-weighted silk were not determined on separate samples as was the case in all the other analyses. The average of three determinations has been used in each instance.

After treatment with 300 cc. of water, hydrochloric acid, or sodium hydroxide in 500-cc. Erlenmeyer flasks at 40° ± 0.1° C. for 10 hours[84] five-gram samples of the weighted silks were rinsed, and either again dried to constant weight at 105° C. before ignition or analyzed for nitrogen. The breaking strength specimens were tested at once. All weighings of bottles and crucibles were made with tares.

Discussion of Results

Tables I-A, I-B, I-C and I-D give the analysis of the silk fabrics. The percentages for total nitrogen of the weighted silks are greater (1.3 to 2.06) than those calculated from fibroin obtained by difference; this discrepancy[22, 77] may be explained by the method of analysis for weighting,[2] or by the presence of nitrogenous finishing substance. The percentage of total phosphorus in the tin-weighted silk, 0.45, is lower than recorded in the literature; Gnehm and Bänziger reported phosphorus 0.7 to 2.9%,[21] Heermann as 1.2%,[39] Schotte as 1.3 to 1.6%,[67] and Weltzien, Schotte, and Corsten as 0.9 to 2.0% of tin-weighted silks.[80] The percentage of silica, 20.49, comes within the range reported for tin-weighted silks; Gnehm and Bänziger reported 5.7 to 11.8%,[21] Southard and Tague 21.1%,[77] Schotte

Table I-A

Analysis of Yarns in Fabrics

Fabric	Number per in.		Percentage of Fabric		Count typp		Twist*		Ash % of Yarn	
							No. per in.	% Deviation		
	Warp	Filling	Warp	Filling	Warp	Filling	Filling	Filling	Warp	Filling
A. Iron-weighted black silk crêpe	168	71	68.6	31.0	51.6	40.4	58	8	49.3	47.6
B. Lead-weighted white silk crêpe	129	72	62.7	36.4	37.2	38.0	71	8	46.1	42.4
C. Tin-weighted white silk crêpe	155	73	65.1	34.9	44.8	44.8	75	7	54.2	52.9
D. Tin-lead-weighted white silk crêpe	180	79	71.4	28.5	45.4	48.5	84	5	52.6	48.7
E. Zinc-weighted white silk crêpe	170	71	73.0	26.0	51.9	48.5	62	5	53.7	49.9
F. Degummed silk crêpe	256	63	64.9	34.5	123.7	51.0	57	1		

* Two left-twisted filling yarns alternated with two right-twisted filling yarns. The warp yarns were not measurably twisted.

Table I-B

Physical Analysis of Fabrics

Fabric	Weight ozs. per sq. yd.	Thickness in.	Breaking Strength						Elongation at Breaking Load				Folding Endurance			
			Dry Resistance				Wet Resistance % of Dry		Dry %		Wet %		Double Folds per cm. Fabric	% Deviation	Double Folds per cm. Fabric	% Deviation
			lbs. per in.		% Deviation											
			Warp	Warp	Filling	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Warp	Filling	Filling
A.	2.90	0.0065	48	2	17	0	75	65	17	17	42	50	2274	7	9601	10
B.	2.94	0.0063	46	2	14	7	57	79	13	13	25	33	563	11	2112	17
C.	2.86	0.0063	44	2	14	4	66	67	13	17	29	38	1275	13	3889	19
D.	3.15	0.0065	52	1	17	4	60	59	13	13	42	21	804	13	4383	14
E.	2.87	0.0062	50	1	15	5	62	60	21	17	38	38	2141	7	9440	15
F.	1.91	0.0082	52	2	11	5	81	64	25	50	33	44	2473	5	2267	7

F.....	1.91	0.0082	52	2	11	5	81	64	25	50	33	44	2473	5	2267	7

TABLE I-C

Flexural Properties of Fabrics

Fabric	Spring Deflection at 5° Angle				Flexural Work		Recovered Work						Flexural Resilience %	
	Degree	% Deviation	Degree	% Deviation	Erg	% Deviation	Erg	% Deviation	Erg	% Deviation	Erg	% Deviation		
	Warp	Warp	Filling	Filling	Warp	Warp	Filling	Filling	Warp	Warp	Filling	Filling	Warp	Filling
A.....	61.6	2.6	12.3	8.1	13,642	0.7	3,363	8.7	10,501	5.0	2,367	11.4	77	70
B.....	36.9	4.5	13.5	9.6	11,073	4.1	4,111	9.1	6,623	6.1	2,363	13.3	60	58
C.....	42.5	0.8	12.5	4.8	10,942	1.3	3,471	6.3	7,627	2.8	2,391	6.5	70	69
D.....	45.4	4.8	12.9	2.5	12,069	2.5	3,468	4.7	9,000	2.3	2,733	4.3	75	79
E.....	42.3	0.1	9.9	7.1	11,729	1.8	2,768	5.2	8,209	1.4	2,102	2.0	70	76
F.....	17.8	2.6	5.0	4.7	4,850	3.8	1,254	2.7	3,336	4.4	806	6.9	69	64

TABLE I-D

Chemical Analysis of Fabrics

Fabric	Nitrogen		Weighting	Ash	Aluminum	Chromium	Iron	Lead	Phosphorus	Silica	Tin	Zinc	Water Extract
	Determined	Calculated											
	% of Silk												
A.....	8.08	6.78	63.5	48.2	trace	0.24	14.05		0.68	17.42			11.3
B.....	9.34	8.03	56.8	43.0	trace			13.62	1.01	21.08			6.9
C.....	9.25	7.19	61.3	52 9					0.45	20.49	8.80		7.2
D.....	8.44	7.28	60.8	50.3	trace			9.10	1.06	14.91	8.66		4.4
E.....	8.36	6.78	63.5	51.9	0.85				0.57	15.04		11.12	4.6
F.....	18.65			0.2									

14.9 to 17.5%,[87] and Weltzien, Schotte, and Corsten 5.9 to 20.1%.[88] However, all these values reported as silica, except those determined by Gnehm and Bänziger, are the insoluble residues from acid extraction. Corresponding values for the ash of these iron-weighted, lead-weighted, tin-weighted, tin-lead-weighted, and zinc-weighted silks, respectively, were 26.2, 28.8, 30.2, 27.6 and 21.7%.

The very evenly weighted fabrics, varying some in structure and total weighting, showed distinct differences in flexural properties, the flexural work in the warp direction of the fabrics decreasing in the order iron-

TABLE II

Analysis of Weighted Silk Fabrics after 10 Hours in Water at 40° C.

Fabric	Weight	Ash	Nitrogen	Breaking Strength of Wet Warp	Elongation at Breaking Load
	% of new fabric			lbs. per in.	%
A.....	89.1	44.4	7.95	36	33
B.....	92.5	42.8	9.25	26	29
C.....	93.1	51.4	8.64	28	46
D.....	96.0	49.1	8.50	28	42
E.....	96.0	50.1	7.67	34	42

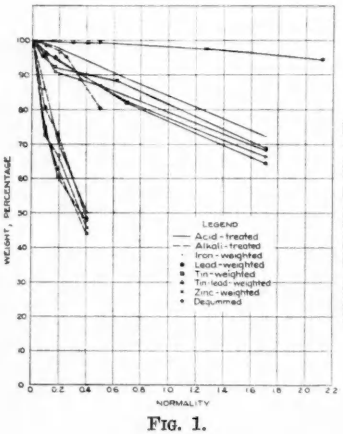

FIG. 1.

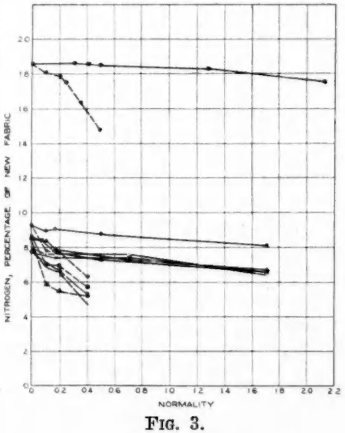

FIG. 3.

FIG. 1. Effect of acid and alkali in 10 hours at 40° C. on the weight of silk fabrics. (Values for degummed silk appearing in Figs. 1, 3, 4 and 5 are from Walde.[84])

FIG. 3. Effect of acid and alkali in 10 hours at 40° C. on the nitrogen of silk fabrics.

weighted, tin-lead-weighted, zinc-weighted, lead-weighted, tin-weighted, and degummed silk.

Table II and Fig. 1 show the loss in weight of the silks. In 10 hours at 40° C. the weighted silks disintegrated at concentrations greater than 1.8 *N* hydrochloric acid or 0.4 *N* sodium hydroxide.

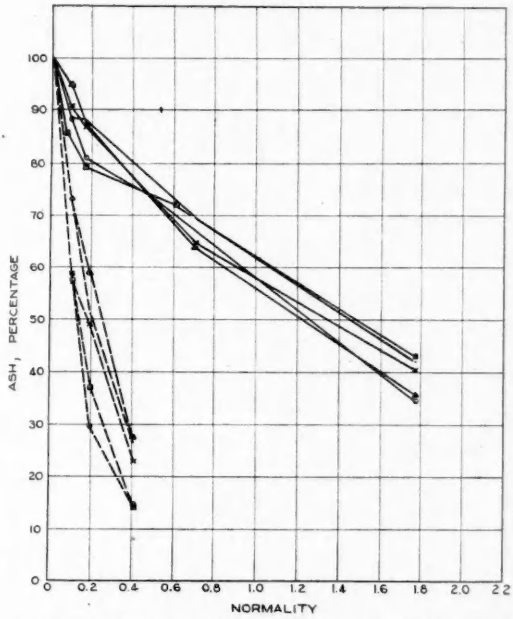

FIG. 2. Effect of acid and alkali in 10 hours at 40° C. on the ash of the weighted silk fabrics.

Fig. 2 shows the relative effectiveness of acid and alkali in extracting weighting from the weighted silks. The nitrogen curves for the weighted silks parallel those for the degummed silk, showing that weighting does not catalyze hydrolytic cleavage of silk fibroin to soluble nitrogenous compounds (Table II and Fig. 3).

Table II and Fig. 4 show the wet warp breaking strengths of the silk fabrics. (Wet breaking strength has been found more uniform than the dry, and weighted silk less brittle when wet than when dry.)[55, 56] In 0.8 *N* acid the degummed silk lost 50% (one criterion of the failure of a fabric for use)[57] of its wet warp breaking strength, and the iron-weighted, lead-weighted, tin-weighted, tin-lead-weighted, and zinc-weighted silks, respectively, lost 33, 46, 37, 46 and 43%. The degummed silk fabric lost 50% of its wet warp breaking strength at 0.2 *N* alkali and the weighted silk fabrics, in the previous order, lost 60, 64, 70, 86 and 80%, far greater losses than occurred in 0.8 *N* acid.

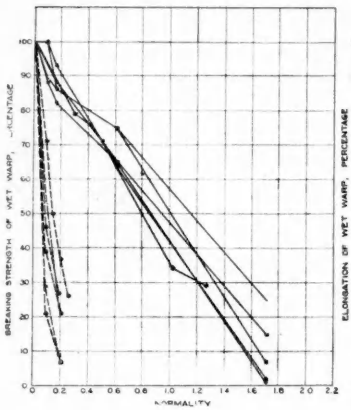

FIG. 4.

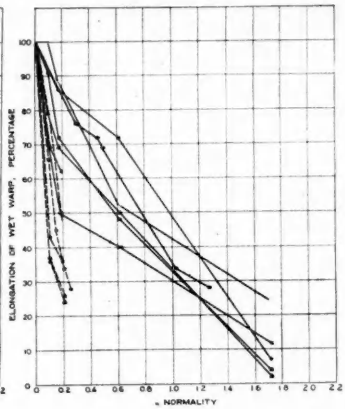

FIG. 5.

FIG. 4. Effect of acid and alkali in 10 hours at 40° C. on the wet warp breaking strength of silk fabrics.

FIG. 5. Effect of acid and alkali in 10 hours at 40° C. on the wet warp elongation of silk fabrics at breaking load.

Table II and Fig. 5 show the warp elongation of the wet fabrics at breaking load. At 0.8 *N* acid and breaking loads of 24, 14, 18, 15, 19 and 19 pounds for the iron-weighted, lead-weighted, tin-weighted, tin-lead-weighted, zinc-weighted and degummed silks, respectively; the losses in elongation, in the same order, were 53, 39, 60, 58, 65 and 51%. In this same order at 0.2 *N* alkali, the values for the breaking loads were 8, 7, 6, 2, 3 and 23 pounds, and the losses in elongation 52, 38, 74, 76, 64 and 66%.

Summary

1. Black iron-weighted and white lead-weighted, tin-weighted, tin-lead-weighted and zinc-weighted plain-woven silk crêpe fabrics have been analyzed, treated for 10 hours at 40° C. in water, hydrochloric acid, or sodium hydroxide, and again analyzed for weight, ash, nitrogen, wet warp breaking strength, and elongation at breaking load.

2. It has been shown that the iron, lead, tin, tin-lead and zinc weighting have no catalytic effect on hydrolytic cleavage of silk fibroin to soluble nitrogenous compounds.

3. The different weighted silks have been shown to deteriorate similarly as measured by solubility and wet warp breaking strength, but differently as measured by wet warp elongation at breaking load. The wet warp breaking strength of weighted silks, compared with that of degummed silk, has been shown higher, in general, after acid and lower after alkaline treatment.

4. Quantitative data have been presented showing the greater action of alkali compared with acid in the solution and mechanical failure of the five weighted silks.

Acknowledgment

The flexural analysis of the silk fabrics was made by Miss Margaret S. Furry of the Bureau of Home Economics, working in the laboratory of Dr. H. F. Schiefer at the Bureau of Standards. Some of the silk was a gift from the Cameo Silk Mills, Inc.

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New Textile Text Books

THE latest development in the plans of the Textile Foundation, in co-operation with the deans of the textile schools to raise the standards of the latter, involves the preparation of new and up-to-date text books on wool and cotton manufacturing, and textile economics. Several conferences on the subject have been held recently, and F. M. Feiker is acting for the Foundation in correlating the work.

The basic material for a text book on cotton carding has been collected and is being prepared for publication by H. H. Willis of Clemson College, S. C., in co-operation with the deans of other schools. The preparation of text material on the following cotton subjects has been authorized: Cotton classification; opening and picking; drawing and roving; combing; spinning. It is expected that some of the cotton text books will be ready for the next Fall term.

The selection of subjects for one or two text books on wool manufacturing has been assigned to Charles H. Eames of Lowell Textile Institute and W. D. Fales of the Rhode Island School of Design. Another project involves the compilation of a text book on textile economics, or economics as specifically related to textile buying, manufacturing, merchandising and financing.

Rapid Microscopical Measurement of Diameters in Cross-Section

By FRED A. MENNERICH *

Abstract

Horizontal micro-projection of the cross-sectional image on to a vertical ground glass screen presents a method whereby a representative field can be measured systematically. The shadow of a coördinate scale is superimposed without magnification upon the same ground glass screen. The observer sits behind the screen; therefore shadows cast by his body do not blot out part of the projected image.

By means of a transparent scale, which has special rulings on it that are at right angles to each other, both the minor and major diameters of a fibre in cross-section can be measured directly in microns with one setting of the scale. Only five minutes are required to measure 100 fibres.

The use of a bundle sizer is described for obtaining the same number of fibres. This instrument is intended for use with metal cross-sectioning plates and facilitates making of the same size sections.

THE present methods for grading wool and of measuring diameters of textile fibres and microscopic particles require much time and considerable effort. There is a definite need for a method which will hasten such measurements. With the aid of a specially ruled transparent scale the technique set forth in the following paragraphs greatly facilitates rapid and accurate measurements with the minimum of expended time, trouble and energy.

Cross-Sectioning of Fibres

The making of paraffin candles and subsequent sectioning with a microtome is a thing of the past as far as the cross-sectioning of textile fibres is concerned. A much more rapid way to prepare a section is to place a bundle of fibres in a wire loop, pull it through a tiny hole in a thin metal plate, and then cut off the projecting ends with a sharp razor blade.[1, 2]

A special though similar device has been designed by Dr. J. I. Hardy. In his method the fibres are held in a narrow slot by a bar which has the same width.[3] Dr. Hardy has also perfected a device whereby thin cross-sections, two and one-half microns thick, can readily be made.[4]

* Microscopist, United States Testing Company, Hoboken, N. J.

The first requirement in making good cross-sections is to reproduce accurately the size of sample bundle. An instrument (Fig. 1) for ad-

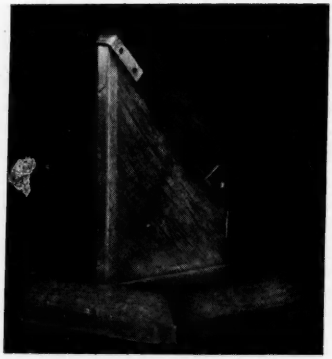

FIG. 1

justing the size of the fibre bundle was designed by the writer in 1933. This instrument is intended for use with metal cross-sectioning plates and permits accurate reproduction of bundle size. It consists of two blocks of hard wood, which are hinged together at one end as shown by the photograph (Fig. 1). At the other end there is a metal scale and an indicator. A small bundle of fibres is selected and combed out with a special brush while the bundle lies on a glass plate. The fibre bundle is threaded through the hole, twisted between the fingers and then pushed forward while a downward pressure is being exerted. This causes a displacement of the upper block. Fibres can be added or removed until the desired bundle size gives a predetermined definite displacement of the indicator. This instrument facilitates the rapid obtaining of the same size bundle.

Projection of the Cross-Sectional Image

The cross-sectional image can be projected upon a horizontal sheet of white cardboard laid upon a table, where examination and measurement of fibre diameters are made. There is one disadvantage encountered when this method is used; the shadows of the observer's hand and head interfere with observations.

A more convenient procedure will now be outlined. The metal plate, which holds the fibres in cross-section, is placed upon the stage of a compound microscope or a micro-projector, which is strongly illuminated through the substage condenser with light from a mechanical-feed arc lamp or a suitable ribbon-filament Mazda bulb. The magnified image of the fibre cross-section and also the shadow of coördinate rulings are projected horizontally on to a vertical ground plate glass screen (Fig. 2). A suitable screen is one which is two feet square.

The coördinate lines on the screen are produced by the shadow from

wires, which are strung back and forth around nail supports on the front of the screen with divisions two cm. square. The projected coördinate lines permit systematic scanning of the magnified field. The observer sits behind the screen and not in the projected beam of light; thus no shadows from his body are cast to blot out part of the image.

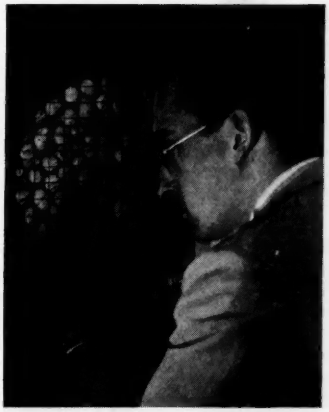

FIG. 2

A linear magnification of 500 diameters is obtained on the ground glass by setting the screen about one meter from the focal point of the ocular when using a 16 mm. objective and a 12.5X ocular. The exact magnification of 500 diameters must be obtained with the aid of a glass-stage micrometer scale by adjusting the position of the screen.

Remote control of focus and field of view should be placed conveniently behind the screen so that the mechanical stage and the fine adjustment screw on the microscope can be moved. The ground surface of the glass screen must be toward the observer in order that parallax is eliminated when measurements are made. The ground glass surface should be made by rubbing with a fine powder (such as "aloxite 400"). A coarse surface will not permit a sharp focus.

Measurement of Diameters

The paper wedge measure as used by Lauth[5] and von Bergen[6] is a unique device and is well suited to the purpose for which it is primarily intended, namely, that of providing a distribution plot for the different sized fibres within a sample. The wedge is large and, for merely obtaining diameters, it is entirely too unwieldy for rapid measurements. Especially is this true when both the minor and major diameters of fibres in cross-section are measured. Fifteen minutes are required to measure 100 fibres longitudinally, and 45 minutes are needed for obtaining both the minor and major diameters of the same number of fibres in cross-section.

A distinctly different type of scale was designed and used by the writer in the early part of 1933. This scale was originally contrived for the purpose of measuring cross-sections; however, it can be used to advantage also on longitudinal mounts.

The scale,* designated as a "bi-diameter scale," has special rulings on it which are at right angles to each other, so that both the minor and major diameters of a fibre in cross-section can be obtained with one setting of the scale (Fig. 3). The extreme left vertical line is placed tangent to the

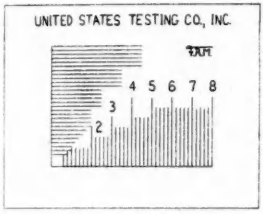

FIG. 3

periphery of the fibre cross-section at a point of major diameter. The long horizontal base line is adjusted tangent to the periphery at a point of minor diameter. With the bi-diameter scale in this position both diameters of the fibre can be read directly in microns with one setting.

The small divisions are one mm. wide and are equal to two microns at a linear magnification of 500 diameters. A reading can readily be made to one-half of a division, which is equivalent to one micron. Average diameters are based upon many fibres and, because the variation in diameters is great, there is no point gained in making individual measurements closer than one micron. The numbers 2, 3, 4, etc. correspond to 20, 30 and 40 microns. Obviously the scale divisions have different values at magnifications other than 500. (Table I.)

TABLE I

Value of Bi-Diameter Scale Divisions at Various Magnifications

Linear Magnification	Value of Scale Division
100	10 microns
200	5 "
250	4 "
500	2 "
1000	1 "

The outstanding advantage of the bi-diameter scale is the ease and rapidity with which measurements can be made. With an assistant, who records the readings directly on an adding machine, 100 fibres from a longitudinal mount can be measured in five minutes. Both minor and major diameters for the same number of fibres in cross-section can be obtained in five minutes.

* Obtainable from United States Testing Co., Hoboken, N. J.

The point will naturally be made that the fibres are not sorted automatically according to their width. A distribution plot for the different sized fibres can be made by recording the diameters in a table as shown in Fig. 4.

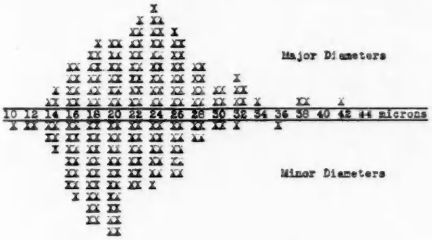

FIG. 4. Size Distribution of Fibres from Bi-diameter Measurements of 100 Wool Fibres.

Application and Other Uses of Bi-Diameter Scale

A brief description of the bundle sizer, the ground glass screen and the bi-diameter scale appeared in a previous paper.[7] Over 100,000 measurements on the effect of the shape and size of silk filaments on two-tone dyeing were made.[7, 8]

The bi-diameter scale was originally designed for the purpose of measuring both the minor and major diameters of a cross-section with one setting of the scale; however, it can be used to good advantage on longitudinal mounts. The scale can also be used when the image is projected vertically on to a white cardboard, or for measuring diameters from photomicrographs.

Some of the other applications that have not been mentioned for which the bi-diameter scale can be used are as follows: fineness of wool fibres; shape and size of rayon filaments and other textile fibres; diameter of yarns; grain size of metallographic sections; size of starch grains, blood corpuscles and other particles; diameter of wires and size of screen openings; and size of rayon spinneret jets.

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(*Continued from Page 190*)

Dr. Katz presented an outline report of his latest work on the sizing project at a recent meeting of the Administration Committee, and it was agreed by certain of those present who have had access to reports on the same subject of foreign research organizations, that much more basic knowledge of starches as sizing materials will be covered in his final report than has been accumulated by years of study abroad.

Member Personals

Dr. Irving J. Saxl has resigned as Director of Research and Development of the Waypoyset Manufacturing Co., Pawtucket, R. I. While he has received several offers, he is seriously considering the establishment of a textile testing laboratory for yarns, sizes and oils that would serve noncompeting mills and raw material producers on a consulting basis, combining this with the manufacture and sale of the many textile testing machines that he has developed and patented. In addition to membership in textile and other scientific bodies, Dr. Saxl is a member of the warp sizing advisory committee of U. S. Institute for Textile Research, and of the joint committee of the Throwsters Research Institute and the American Association of Textile Chemists and Colorists on rayon crêping.

Charles T. Main, president of Charles T. Main, Inc., Boston, Mass., was awarded, at the recent annual meeting of American Society of Mechanical Engineers, the A. S. M. E. medal "for distinguished achievements in the textile and other industries and in engineering education, and for eminent service to the engineering profession."

Robert Taft Pullar, textile scientist and marketing research consultant, has opened offices at 1440 Broadway, New York, N. Y.

Harry Levine, director of the Silk Grading and Testing Laboratory, New York, N. Y., has been elected president of the Association of Textile Laboratories and Technologists succeeding J. J. Reutlinger of Hatch and Reutlinger, resigned.

Fred V. Murphy, Jr., is now in charge of the research department of the Waypoyset Manufacturing Co., Pawtucket, R. I. A graduate of Massachusetts Institute of Technology, he had been assistant to Dr. Irving J. Saxl, who has resigned as director of the Waypoyset's research department.

Abstracts

This section is compiled under the direction of the Committee on Abstracts and Bibliography: Prof. E. R. Schwarz, Chairman, M. W. Weiss, Dr. Irving J. Saxl and C. H. Clark.

I. Fibres (Synthetic and Natural) and Fibre Analysis

Fibre Maturity in Indian Cottons. A. N. Gulati and Nazir Ahmad. *Tex. Mfr.*, Oct. 1935, P. 411.

The effects of cotton fibre maturity and its relation to season, growth, length, fineness, and strength of a cotton. A method of determining maturity is described. (C)

Flax Fibre Characteristics: Their Bearing on the Production and Properties of Wet Spun Yarn. S. A. G. Caldwell. *Tex. Mfr.*, July, 1935, P. 271. (C)

Microstructure of Cellulose. Geo. J. Ritter. *Rayon & Mell. Tex. Mo.*, 1935, Sept., P. 100; Oct., P. 58. (C)

Photochemical Reaction of Cellulose. II. Action of Light and the Copper Number of Some Cellulose Samples. S. Oguri. *J. Soc. Chem. Ind. Japan*, Oct. 1934, P. 620; *Paper Trade J.*, Oct. 3, 1935, P. 42. (C)

Tin-weighting Process: Effect of the—on the Strength of New Silk. Paper I. Winifred M. Forbes and Pauline Beery Mack, *Rayon & Mell. Tex. Mo.*, Dec. 1935, P. 39.

A series of technical studies on unweighted and weighted silk. (C)

Textile Raw Materials and Products: Recognition and Examination of. A Herzog and P. A. Koch. *Mell. Textilber.*, 1935, P. 617; *Rayon & Mell. Tex. Mo.*, Dec. 1935, P. 71.

The authors describe the methods by which cotton can be judged and the qualities separated in a rapid and reliable manner. Dead cotton consists of hairs which have degenerated or died prematurely. In order to be able to express in figures the occurrence of unripe and dead cotton in a given sample, the Herzog gelatine counting process is recommended, which can also be used with polarized light. (C)

Wool Scouring Problem: Some Observations on the. A. T. King. *Tex. Mfr.*, Dec. 1935, P. 483.

A critical examination of requirements in scouring wool, in efficiency and economy, and from a physical and chemical view of the fibre and the subsequent processing of the material. Preservation of fibre length is taken as the main factor of efficiency. (C)

II. Yarns and Fabrics

Stainless Steel in the Rayon and Silk Industries. B. L. Hathorne and Robert Zemetkin. *Am. Dye. Rptr.*, Sept. 9, 1935, P. 503. (C)

Starch Mangle Rolls: Controlled Adjustable Surface Speed Relation Between. H. H. Iler. *Cotton*, Dec. 1935, P. 54. (C)

Static Electricity in Rayon and Other Textile Processes. A. E. Cater. *Tex. Mfr.*, 1935, Vol. LXI, P. 277, 313, 361; *Rayon & Mell. Tex. Mo.*, Oct. 1935, P. 63.

The effects of static electricity are reviewed in particular reference to rayon and rayon staple fibre processes, and a summary is given of suggested methods for preventing unwanted effects. (C)

Stretch and Sizing in Synthetics. Anon. *Am. W. & C. Rptr.*, Oct. 3, 1935, P. 7.

Variations and defects in yarns and fabrics are studied, and a tabular summary of results of tests confirms generally held ideas. (C)

Warp Sizing. Paul Seydel. *Cotton*, 1935, Nov., P. 43; Dec., P. 44.

The first two of a series of articles covering the different phases of warp sizing, largely with respect to the materials used in the operation of slashing—flour and starches; gums and glues; lubricants, fats and softeners; chemicals; weighting and other chemicals; etc. (C)

Weaving Rayon Fabrics: Improvements for. *Tex. Mfr.*, Sept. 1935, P. 371.

Starting and stopping marks in rayon fabrics woven on loose-reed looms are avoided by a patent heater reed motion. A new form of loom driving clutch is also described. (C)

Weighted Silk: Accelerated Aging Test for. W. D. Appel and D. A. Jessup. *Am. Dye. Rptr.*, Dec. 16, 1935, P. 706. (C)

Worsted Yarns: Effect of Quality and Fibre Length on the Strength of Single. G. R. Stanbury. *Tex. Mfr.*, July, 1935, P. 291. (C)

Worsted Yarn Twist: Effect of Single—on Folded Yarn Strength. S. Kershaw. *Tex. Mfr.*, July, 1935, P. 280.

YARNS AND FABRICS: VARIATIONS IN. Anon. *Am. W. & C. Rptr.*, Oct. 3, 1935, P. 9.

Effect of sizing on synthetic materials is shown by tests, also changes in tensile strength and elongation of yarns and fabrics. Results are tabulated. (C)

(YARN SLIPPAGE:) IT'S PULLED AT THE SEAM! Ruby K. Worner. *Tex. Wld.*, Dec. 1935, P. 80. (C)

III. CHEMICAL AND OTHER PROCESSING (NOT OTHERWISE CLASSIFIED)

MALT DIASTASE: ACTION OF ORGANIC SUBSTANCES. M. Hamburg and S. Pickholz. *Brau. Malzind.*, 1935, V. 28, P. 26–9 (through *J. Inst. Brew.*, 1935, V. 41, P. 226).

The effect has been investigated of the addition at 77° F. of various organic substances on the diastatic power of a malt solution. The saccharifying power alone of the diastase is influenced, the liquefying power remaining more or less constant. Except with formaldehyde, and to a less extent with phenol, inactivation does not occur if the mixture is kept at rest; shaking or stirring is necessary. Maximum inactivation effects are obtained with the aromatic hydrocarbons, the effect being increased with the introduction of side chains. Acetic acid, acetaldehyde and ethyl acetate show anomalous behaviour in that they slightly increase the activity of the enzyme. (From *J. T. I.*, Aug. 1935, P. A429.) (C)

MERCERIZATION: DETERMINATION OF THE VALUE OF AUXILIARY AGENTS FOR. S. Replat. *Tiba*, 1935, V. 13, P. 81–7.

A brief outline of the use and function of auxiliary agents in mercerizing, with a review of the methods and apps. used in detg. their stability toward NaOH and their indirect action on fibres. (From *C. A.*, 1935, V. 29, Col. 3171.) (W)

MERCERIZATION: IODOMETRIC CONTROL OF. P. V. Rogovina and O. A. Mebus. *J. Applied Chem.* (U. S. S. R.), 1934, V. 7, P. 989–96.

The Schwertasseck method (*C. A.*, V. 26, P. 2323) was studied to det. the effects (1) of duration of exposure of the yarn to I, (2) of duration of digestion of the treated yarn in Na_2SO_4 soln., and (3) of concn. of I soln. on the adsorption. It was found the I-adsorption method is suitable for control analysis in detg. the degree of mercerization. The sensitivity of the method decreases with a lowering in the concn. of I. With the same concn. of I, the adsorption nos. for various grades of untreated yarn are almost identical. The adsorption nos. of mercerized yarn depend not only upon the conditions of mercerization but also on treatment after the mercerization. A non-uniform I adsorption by the mercerized yarn indicates that dyeing will not be uniform. (From *C. A.*, 1935, V. 29, Col. 5663.) (W)

METHYLENE BLUE: SHADE OF. K. D. Shcherbachev. *Rekon. Tekstil. Prom.*, 1934, V. 13, No. 5, P. 34–5; *Chim. et Ind.*, V. 33, P. 158; *C. A.*, 1935, V. 29, Col. 3165. (W)

MORDANTING AND DYEING. XXI. INVESTIGATION OF CHEMICAL REACTIONS IN GELATIN BY MEANS OF MEASUREMENTS OF LIGHT ABSORPTION. E. Elöd and Th. Schachowsky. *Trans. Faraday Soc.*, 1935, V. 31, P. 216–30; *C. A.*, 1934, V. 28, Col. 7064; 1935, V. 29, Col. 3192. (W)

MORDANTING AND DYEING PROCESSES. XXII. REACTION BETWEEN PROTEIN FIBRES AND SUBSTANTIVE DYESTUFFS. E. Elöd and N. Balla. *Trans. Faraday Soc.*, 1935, V. 31, P. 305–17. XXIV. Dyeing of Weighted and Non-weighted Natural Silk. *Monatsh. Seide Kunstseide*, 1935, V. 40, P. 12–15, 57–61; *C. A.*, 1935, V. 29, Col. 3166, 4946; *Mell. Textilber.*, 1935, V. 16, P. 201–4. (W)

NAPHTHOLS: RELATIONSHIP BETWEEN CONSTITUTION AND SUBSTANTIVITY OF —WITH AFFINITY FOR COTTON. Hans Krzikalla and Bernd Eistert. *J. prakt. Chem.*, 1935, V. 143, P. 50–8; *C. A.*, 1935, V. 29, Col. 5659.

The new compd. homonaphthol AS, 2-hydroxynaphthyl-3-acetanilide, which differs from naphthol AS in having its acid amido group sepd. from the naphthyl nucleus by—CH_2—gives yellower, less fast dyeings on cotton with diazotized bases. (W)

OXYCELLULOSE IN COTTON FABRIC BLEACHED FOR DYEING. TWO METHODS BY WHICH ITS "DYE-RESIST" PROPERTIES CAN BE OBVIATED. A. J. Hall. *Tex. Wkly.*, 1935, V. 15, P. 220.

Expts. with several dyes at varying pH values showed that fabric contg. patches of oxycellulose dyed evenly in acid but not in alk. soln. The fabric was moistened in a soln. contg. one pint formic acid in 25 gal. water and then dyed with direct dyes. Oxycellulose patches do not cause uneven dyeing with vat dyes so that even dyeing can also be obtained by using vat dyes in place of the cheaper direct dyes. (From *C. A.*, 1935, V. 29, Col. 3170.) (W)

PRINTING: FIXING WITH ALBUMIN IN. Justin-Mueller. *Dyer*, V. 73, P. 273–4; *Tiba*, 1934, V. 12, P. 821, 823, 825; *C. A.*, 1935, V. 29, Col. 3167. (W)

PRINTING ACETATE SILK: DEVELOPMENTS IN. H. Yorke. *Dyer*, 1935, V. 73, P. 281.

Methods for avoiding indistinct outlines in discharge-printing acetate rayon, selection of discharging agents, production of novel effects, and printing with aniline black are discussed briefly. (From *C. A.*, 1935, V. 29, Col. 3166.) (W)

YELLOWING OF WOOL UNDER THE ACTION OF ULTRAVIOLET LIGHT. A. Castiglioni. *Chimica e industria* (Italy), 1935, V. 17, P. 82–4.

Yellowing is due to the formation of H_2SO_4 by the oxidation of the S in the wool. Wool placed in a pan of water and exposed to ultraviolet light is discolored just as with dil. H_2SO_4. Degreased wool tends to turn gray rather than yellow to brown, as untreated wool does. That is, the H_2SO_4 formed acts on the cholesterols of the wool. This is confirmed by the fact that a similar color is obtained when cholesterol is $CHCl_3$ soln. is

shaken with H_2SO_4. Here a dye is actually formed, as it will dye wool a permanent yellow color. (From *C. A.*, 1935, V. 29, Col. 5276.) (W)

RAYON: SIZING. *Kunstseide*, 1935, V. 17, P. 178–9.

The preparation of sizes for rayon from a mixture of casein, dextrin and dextrose or other suitable hygroscopic substance, from linoxyn, and from drying oils is briefly described. Uneven distribution of oil sizes in yarn packages may be prevented if the yarn, after impregnation with an oil solution, is treated with a liquid which is miscible with the solvent but in which the oil is less soluble or insoluble. Particularly good results are obtained by the use of oils which have been oxidized and polymerized by treatment with oxygen or ozone at high temperatures. The following procedure is recommended: Linseed oil is oxidized and polymerized by blowing air through it at 100° C. until the iodine number is 65. The mass is then dissolved to a 10% solution in acetone, and benzine with a boiling point of 90–100° C. is added until the oil begins to separate. When rayon wound on bobbins is impregnated with this mixture the acetone evaporates more quickly than the benzine and the gel structure of the system becomes more marked. The oil is unable to migrate by capillary action and even distribution of the size is ensured. (From *J. T. I.*, Aug. 1935, P. A396.) (C)

IV. Research Methods and Apparatus

SPECTROPHOTOMETER: NEW RECORDING. Arthur C. Hardy. *J. Opt. Soc. Am.*, Sept. 1935, P. 305. (C)

SPECTROPHOTOMETERS OF THE POLARIZING TYPE: INTERPRETATION OF DATA OBTAINED WITH. Robert D. Nutting. *J. Opt. Soc. Am.*, July, 1935, P. 211–217.

Many spectrophotometers utilize polarizing prisms and determine the reflection factor of the sample by plane polarized light. In general, the reflection factor of the sample is independent of the azimuth of the plane of polarization but there are some materials, notably textiles, for which the reflection factor depends upon the azimuth. It can be shown mathematically that, if the reflection factor is determined for two azimuths at right angles to one another, the arithmetic average of the two values is the reflection factor for ordinary, or unpolarized light. This is true regardless of the azimuths selected. Experimental data are presented which indicate the applicability of this principle to the measurement of the color of textile fabrics. (Also published in *Tex. Rsch.*, V, 9, 391–400 (1935)). (S)

TENSILE STRENGTH STANDARDS. Anon. *Am. W. & C. Rptr.*, Nov. 21, 1935, P. 21.

Some of the facts that are believed to have been established by the results of described and tabulated comparative tests on viscose, acetate, and cotton yarns and fabrics are in part as follows: That acetate yarns and fabrics generally are weaker than viscose. That what the fabric strength should be for the warp and filling of a cloth can be figured accurately when the tensile strength of the yarn delivered and used is known. That fabrics

of viscose yarns are generally decidedly stronger than similar cloths of cotton, even though weaving into cloth increases the strength of the cotton yarn, while it does not do this for synthetic yarns. (C)

VOLUMETRIC DETERMINATION OF FATTY ACIDS IN SOAPS. W. Stuewe. *Chem. Ztg.*, 1935, P. 468; *Rayon & Mell. Tex. Mo.*, Dec. 1935, P. 75. (C)

WATER: TESTS TO DETERMINE DURABILITY AND RESISTANCE TO—OF CERTAIN UMBRELLA FABRICS. Viola Sykes and Katherine Cranor. *Am. Dye Rptr.*, Dec. 30, 1935, P. 725. (C)

WOOL: TESTING OF THE PHYSICAL AND CHEMICAL PROPERTIES OF—BY MEANS OF THE MICROSCOPE. Werner Von Bergen. *Rayon & Mell. Tex. Mo.*, 1935, Sept., P. 103; Oct., P. 51. (C)

YARN TESTING: STATISTICS IN. A. H. Milnes. *Tex. Mfr.*, Dec. 1935, P. 486.

Some observations on the statistical use of yarn testing results and an example of a proposed new system. (C)

V. ECONOMICS, PHYSICS AND MISCELLANY

COLOR ANALYSIS AND SPECIFICATION. Joseph Razek. *Paper Trade J.*, Sept. 26, 1935, P. 91.

A general outline of the spectrophotometric method of color analysis is given followed by the method of reduction to trilinear coördinates in accordance with the procedure suggested by the International Committee on Illumination in 1931. Calculation and significance of dominant wave length, colorimetric purity and relative brightness are discussed and a sample calculation given. In the case of white samples, a further calculation from the trilinear coördinates makes possible the calculation of "whiteness" in accordance with Judd's formula. (C)

MOLECULAR STRUCTURE OF CARBOHYDRATES. W. N. Haworth. *Tex. Mfr.*, Sept. 1935, P. 387.

Up to ten years ago scarcely anything was known of the chemical constitution of cellulose and starch, both important to textile industries. Their structure has now been elucidated and many aspects of their behaviour explained. (C)

PAPER: OPTICAL CHARACTERISTICS OF. I. MATHEMATICAL RELATIONSHIPS BETWEEN BASIS WEIGHT, REFLECTANCE, CONTRAST RATIO, AND OTHER OPTICAL PROPERTIES. F. A. Steele. *Paper Trade J.*, Mar. 21, P. 37–42; Nov. 21, 1935. P. 47. (C)

WASTE LIQUORS AND GASES OF THE PAPER INDUSTRY. C. J. West. *Paper Trade J.*, Nov. 28, 1935, P. 43.

A survey of recent domestic and foreign patent literature on the utilization of waste liquors and waste gases of the pulp industry, 1931–35 (third compilation). (C)